

REMARKS/ARGUMENTS

By this Amendment, claim 4 is cancelled, and claims 1, 3, 5 and 7 are amended. Claims 1-3 and 5-33 are pending.

Favorable reconsideration is respectfully requested in view of the foregoing amendments and the following remarks.

Applicants hereby affirm their prior election of Group I, claims 1-20, reserving their rights under 35 USC § 121 to file a divisional application for the non-elected claims. Accordingly, claims 21-33 are withdrawn from consideration.

Claim Rejection – 35 U.S.C. § 102

Claims 1-3, 7, 10-13 and 15 stand rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by US 5454472 (Benecke). This rejection is respectfully traversed.

The Office Action at page 7 acknowledges that Benecke “does not teach specifically a deflecting potential is formed by a direct voltage field” as recited in claim 4. Base claim 1 has been amended to incorporate this limitation from claim 4, which has been cancelled. Accordingly, Benecke does not disclose all the features of the claimed invention, and therefore does not anticipate claims 1-3, 7, 10-13 and 15.

Reconsideration and withdrawal of the anticipation rejection of claims 1-3, 7, 10-13 and 15 over Benecke are respectfully requested.

Claim Rejections – 35 U.S.C. § 103

Claims 4, 6, 8, 9, 14, 16, 17, 19 and 20 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Benecke. Claim 5 stands rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Benecke as further evidenced by US 6783647 (Culbertson). Claim 18 stands rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Benecke in view of US 20010023825 (Frumin). These rejections are respectfully traversed.

Summary of Benecke

Benecke discloses a method of separating mixtures of dielectric particles e.g., in liquid suspensions. Benecke discloses two basic embodiments, which are summarized in the passage of column 1 (line 63) to column 2 (line 10) and further specified in figure 1 (embodiment a) and figure 3 (embodiment b). Before discussing details, it is to be noted that Benecke discloses the embodiments a and b as distinct alternatives, but not a combination of both embodiments.

Embodiment a: According to figure 1 (or figure 2), the particles are moved under the influence of a high-frequency field (guiding field). The high-frequency voltage applied to the electrodes 3, 4 causes the particles in the passage 9 to move through the chamber 10 (column 5, lines 48 to 52). There is no liquid flow for moving the particles.

During the movement along the passage 9, particles are deflected depending on the electrical properties thereof. On the basis of the electrophoretic effect (column 5, line 54), one particle species is deflected out of the passage 9.

Thus, in embodiment a, the high-frequency fields are used for moving all particles but not for separating them.

Embodiment b: With the second embodiment, the particles are moved by the flow of the suspension medium (column 6, lines 29, 30). The particles are moved along electrodes (shown in figure 3) creating field inhomogeneities. Under the influence of high-frequency voltages, dielectrophoretic forces are applied to the particles, which can be separated from each other depending on the dielectric properties thereof.

Summary of Claimed Invention

According to the invention, particles are moved with a suspension fluid through a channel. In this regard, the invention is similar to the embodiment b of Benecke et al. (Benecke, figure 3). In the channel, the particles are influenced by two difference separating fields. Firstly, a deflection potential is created, causing a movement of particles by electrophoresis. Secondly, a focusing field is applied for moving the particles by dielectrophoresis. As a result, the particles are moved towards two different flow regions within the liquid flow in the channel as shown in figures 1 to 3. The inventive separation occurs within the flowing liquid, i.e. without an out-coupling out of the moving liquid. This represents an essential advantage compared with conventional techniques, which in particular is important in microfluidic techniques wherein a continuous flow even with different particle fractions is to be kept.

As a further advantage, using two different separating potentials allows an adjustment and adaptation of the separation effect to the particles to be separated (present description, page 6, paragraph 2, to page 7, paragraph 1).

Non-obviousness of Claimed Invention

As noted above with respect to the anticipation rejection, Benecke fails to anticipate the feature of the deflecting potential being formed by a direct voltage field, as recited in base claim 1.

Contrary to the Office Action at page 7, it would not have been obvious to a person of ordinary skill in the art (a “POSA”) to modify the teachings of Benecke to reach the claimed invention. In particular, Benecke discloses one single deflection potential only, but not the superposition of two deflection potentials. With both embodiments a and b of Benecke, the particles separated from the remaining particles are immobilized, e.g., at the membrane 11 (figure 1) or by feeding out particles from the mixture (Benecke at column 6, paragraph 4).

Moreover, Benecke does not disclose any indication or suggestion to introduce a second separation force. Embodiments a and b could not be improved with the inventive technique.

The secondary references represent technology background with regard to the present inventive particle separation using a superposition of electrophoresis and dielectrophoresis in liquid flows.

Culbertson is cited as teaching that it is well known in the art to conduct cell lysis under applied electric fields, clearly failing to remedy the aforementioned deficiencies of the primary reference, Benecke, with respect to the claimed invention.

Frumin at Paragraph 0275 discloses that electrophoretic and dielectrophoretic forces can be combined to create “virtual traps” which “appear at points along the channel where the total velocity due to electrophoretic and dielectrophoretic forces acting on a specific fraction is equal [to] zero.” Frumin at Paragraph 0276 discloses that these virtual traps enable “the accumulation and focussing of specific fractions in preset locations along the separation channel for the fast detection and extraction.” Contrary to the Office Action at page 11, Paragraph 0274 does not speak to separating particles in different flow paths. Moreover, Figs. 52C and 52D, which are also cited for support in the Office Action, are virtually indecipherable as published on the PTO website (see right).



Fig. 52 C



Fig. 52 D

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Thus, Culbertson and Frumin do not disclose any features which in combination with the teachings of Benecke would lead to the present invention.

Accordingly, reconsideration and withdrawal of the obviousness rejections are respectfully requested.

For at least the reasons set forth above, it is respectfully submitted that the above-identified application is in condition for allowance. Favorable reconsideration and prompt allowance of the claims are respectfully requested.

Should the Examiner believe that anything further is desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

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